

## THE GEAR OF BICYCLES.

How a High-Geared Wheel Gains Speed at the Expense of Power.

There are two questions which every bicycle rider asks—"What make do you ride?" and "What is the gear?" Probably there is not one rider out of a hundred who has any very clear idea of what gearing really means.

There is also probably no feature of the wheel which is more discussed or in which a wider difference of dimensions exists than in the gearing. At last the Scientific American has taken the subject up, and, with the picture, which is printed below, has this to say on the gearing:

"There are thousands of riders who have no clear perception of the change of mechanical conditions which takes place when, by substitution of a smaller sprocket on the rear wheel, a rider 'raises the gear' of his machine.

"True, when he mounts and begins to apply pressure to the pedals, he is sensible of a change which in its effects is truly remarkable. If his first ride with the high gear be taken on a smooth and level road, for the first few revolutions of the cranks he will be disappointed, if not disgusted, at the sluggishness of the machine, and he will have to apply a much greater pressure to the pedals than was necessary on the old gear.

"When the bicycle is fully in motion, however, he will be agreeably surprised to find that, with the same speed of rotation of his pedals as with the low gear, and apparently with the same pressure, he covers what to his pleased and excited imagination appears to be fifty per cent more distance. His satisfaction will last until the first hill or a head wind is encountered, when all the life and mettle will suddenly die out of his 'high gear' wheel, and to the redoubled pressure on the pedals there will be apparently but little response.

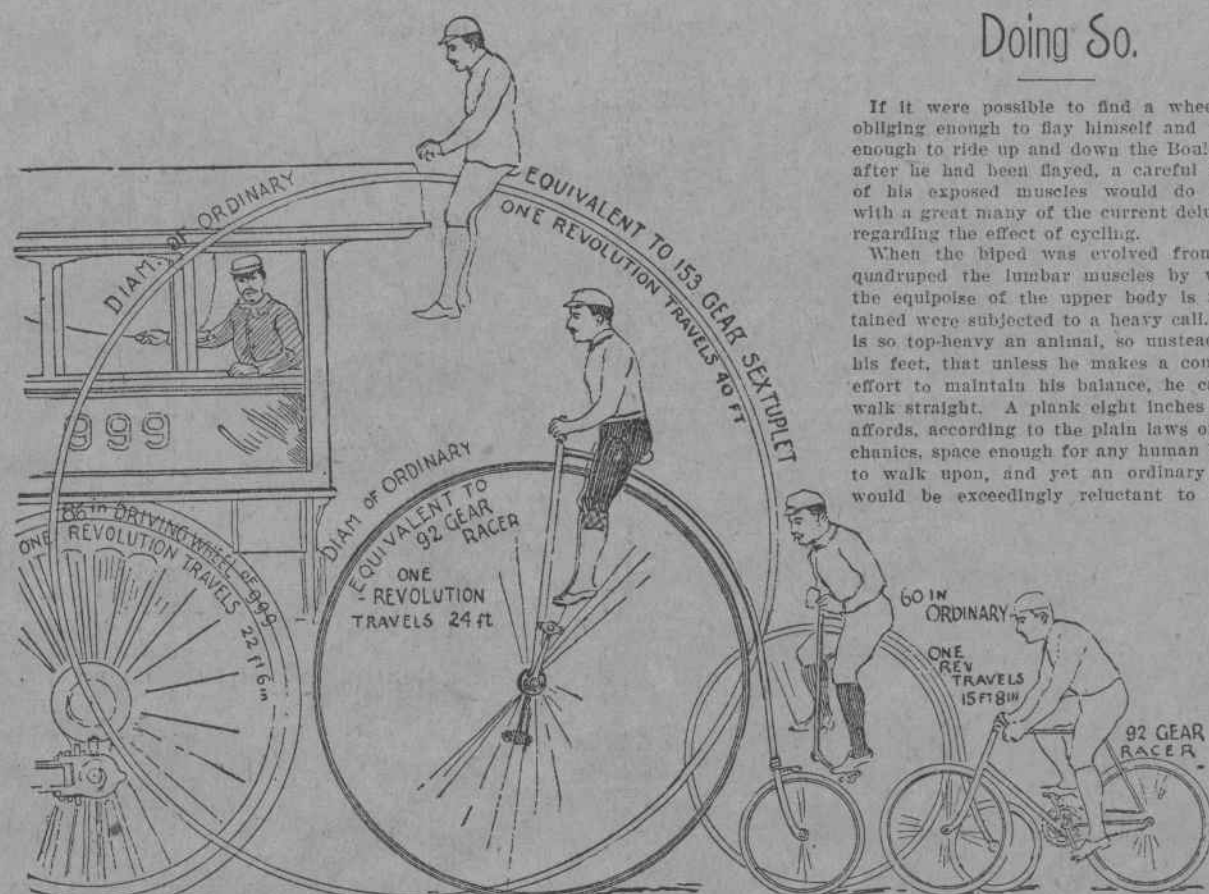
"For the benefit of those of our readers who may not have a clear conception of the part played by 'gear' in the mechanics of the bicycle we have prepared the accompanying diagram. The comparison is based upon the proportions of the now extinct 'ordinary,' or high wheel, bicycle; and it shows how the introduction of the rear-driven 'safety,' with its multiplying gear, has increased the capacity of the bicycle in respect of the amount of ground which can be covered by one revolution of the pedals. In the old 'ordinary' bicycle, in

is one of the lever, in which the radius of the driving wheel is the long arm, the crank the short arm, the resistance being applied at the long arm and the power at the short arm. When the machine is running at any given speed the pressure on the pedal, multiplied by the crank length, will just equal the total resistance of the machine (due to internal friction, wind, the irregularity of the ground, and the inclination of the grade, if climbing a hill), multiplied by the theoretical radius of the driving wheel.

"Evidently, if the driving wheel, or gear, be increased, the length of the crank should be increased in like proportion if the pressure on the pedals is to remain the

The machinery is a "gear" instead of being worked by sprocket chain, with three bevel wheels acting upon each other, so that the water bicycle is of extra "high gear." An eight-inch diameter bevel runs on one three and a half inches in diameter, and revolving on the same shaft with this small wheel is one of greater diameter. This third pinion bevels on a still smaller fourth attached to the propeller shaft. Thus, while one turn of the pedal cranks of a bicycle drives the rear wheel about three and a quarter times around, on a water bike they will whirl that propeller many more times.

The inventor calculates that the vessel



BICYCLE GEARS AND THEIR EQUIVALENTS.

same, and in general it will be found advisable to do this. On the other hand, increased length of cranks means greater travel of the rider's leg, or increased "knee action," and an increased fatigue on this account alone.

"As a rule, it may be said that the question of gear must be determined by the general make-up of the rider himself. The man of quick, nervous action will do better work with moderate gear and rapid stroke, while high gear and slower stroke will suit the more powerful but less active rider."

will go eight and three-quarter miles an hour at forty revolutions of the propeller per minute, and that after a few alterations have been made in the machinery, she will speed twelve miles an hour, the rider easily driving the propeller up to seventy and eighty revolutions.

The hull of the boat is 12 feet 6 inches in length from stem to stern, 3 feet 3 inches wide amidships, and the draught of water is from 8 to 14 inches. The boat has air-tight tanks in the fore and aft ends. The machinery and shaft run on ball-bearings, those of the shaft being arranged so as to

## BICYCLE MUSCLES.

Why the Wheel Strengthens the Back Without Apparently Doing So.

If it were possible to find a wheelman obliging enough to flay himself and tough enough to ride up and down the Boulevard after he had been flayed, a careful study of his exposed muscles would do away with a great many of the current delusions regarding the effect of cycling.

When the biped was evolved from the quadruped the lumbar muscles by which the equis of the upper body is maintained were subjected to a heavy call. Man is so top-heavy an animal, so unsteady on his feet, that unless he makes a constant effort to maintain his balance, he cannot walk straight. A plank eight inches wide affords, according to the plain laws of mechanics, space enough for any human being to walk upon, and yet an ordinary man would be exceedingly reluctant to cross

an unprotected bridge only eight inches wide. If he is blindfolded he cannot even follow a path eight feet wide. His natural tendency to sway and topple is such that in order to steer a straight course he must look at some object ahead to rectify his position and his direction when he finds that they are defective. In doing this he is constantly employing the lumbar muscles, just behind and beneath the lower ribs, and this is the weak point in his structure. Most of the backaches which are ascribed to disorders of various organs are, in fact, caused by the unre-

How it cures COMMON CATARRH.

Here is a patient taking treatment for Catarrh of the Head. He breathes the soothing medication through his nostrils, and the nasal channels open up, the stuffed-up feeling in the head leaves, and he can breathe naturally through the nose again. The dull pains across the front of the head fade away, and the nasal membrane is soothed until the inflammation and soreness are all gone. The bad odor of the breath passes away, and the lost sense of smell returns. The dropping in the throat is checked, the nose does not stop up at night any more, the sneezing and sniffing have ceased, and the discharge from the nose grows less and less, and finally stops altogether. The disease has been checked and eradicated from the system before it even reached his throat. It has not been driven down into his throat or into his lungs or into his ears, as so often is done by other treatments.

How it cures CATARRH IN THE THROAT.

Here is another patient who had Catarrh in the Head. He caught cold after cold, and the disease spread down into his throat. He breathes and drinks in the disease-banishing medication. It bathes the membranes of his head and throat. The soreness of the head and throat becomes less and the desire to hawk and spit is disappearing. The nose of the patient is returning and the voice again becomes soft and melodious. There is no more sneezing and vomiting in the morning. No longer does every exposure to the weather result in a stuffed-up throat that becomes sore and inflamed, and no longer does he find his throat and tongue dry as chips when he wakes from an unrefreshing sleep.

How it cures CATARRH OF VOCAL CORDS.

Here is another patient who contracted Catarrh that extended from the throat into the glottis, the gateway that opens to the windpipe and lungs. The disease attacks the vocal cords, this sensitive instrument of the human voice, and soon mars its sweet tones or destroys them altogether. Here sits a lady inhaling the soothing preparation. She had been ten years silent, and the treatment has already restored her voice. Who can say what joy she feels in being restored to the usefulness and the pleasure of conversation?

How it cures CATARRH OF DEAFNESS.

Here is another patient who for years had been a sufferer. Every fresh cold seemed to stay longer than former colds, and he noticed that his ears got stopped up, and his hearing became duller and duller, and there were ringing and buzzing noises in his ears. The Catarrh had passed upward from the throat and reached the throat along the Eustachian tube leading from the throat into the ear. He had visited throat doctors and ear doctors and Catarrh doctors without relief. In this condition we find him inhaling the never-failing medication, and soon he notices a change. The noises in the ears stop, there is no more discharge, the ears getting better, and finally the tubes of the ears open up and something seems to give way in his head. His hearing has completely returned. No wonder he considers the result a marvel.

How it cures BRONCHIAL CATARRH.

Here is another patient who was always sensitive to the weather. He contracted Catarrh of the Head, and it passed to his throat, then down the windpipe and into the bronchial tubes. He coughed at night so that he could not sleep; there was pain behind his breast bone and under the shoulder blades. When he coughed he brought up a frothy, grayish material streaked with blood. He lost appetite and strength. He tried cough syrups and different medicines to no avail. He now breathes with full inspirations the restoring and soothing medication. The sore spots along the bronchial tubes heal, and cough ceases, the pain leaves. The appetite and strength return. He is again a well and happy man.

How it cures CATARRH OF THE LUNGS.

Here is another pitiful case. He had all the history of colds and catarrh, extending downward from the nose to throat, to glottis, to windpipe, to the bronchial tubes, and then into the small tubes of the lungs. His cough always troubled him. He raised large quantities of vile looking material, and he had fever every afternoon and could not sleep at night. He had no appetite, and his strength and ambition failed. He had night sweats every once in awhile, and feared that his end was near.

See him after four months of treatment! A new man. The healing and soothing medication has time after time sought out every nook of the disease, even to the extreme depth of the lung cells, and bathed and cooled and healed the membranes. There is no more of the nasty discharges, no more cough, no more fever, no more pain, no more night sweats. The appetite returns, and with it come back strength and ambition. The cheeks fill out and regain their color. The step becomes buoyant. He has been saved from a lingering and absolutely sure death.

## THE TREATMENT THAT CURES.

How Doctor Copeland's Wonderful Medication Does Its Beneficent Work for Suffering Humanity.

It Reaches, Soothes and Heals Every Part of the Mucous Membrane, Curing Invariably All Forms of Catarrhal Disease of the Nose, Throat, Vocal Cords, Bronchial Tubes, Lungs and Deafness—Doctor Copeland Gives His Famous Symptom Questions, Describing Disease in Its Different Forms, and Cites Instances of Notable Cures.

### THE TREATMENT THAT CURES.

Doctor Copeland's new treatment, that has lifted the darkness and blight of the word "incurable" from hundreds of thousands of these cases of Catarrh in the Ears, Bronchial Tubes and Lungs, works its curative action for two reasons:

(1) It reaches every sore spot, from the orifice of the nose to the deepest part of the lungs, to the innermost recesses of the middle ear, and feeding the area of the disease, it soothes, quiets, heals and cures.

What is this treatment that cures these conditions, once regarded incurable? By what process does it restore the diseased membrane, remove the poison and relieve the soreness of disease? Let the experience of patients cured and being cured tell.

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### THE PROPER COURSE FOR SUFFERERS.

The proper course for sufferers is this: Read these symptoms carefully over, mark those that apply to your case, and bring this with you to either of the Copeland offices. If you live away from the city, send them by mail and ask for home treatment. In either instance, and whether by mail or office treatment, the patient may be assured of the speediest relief and cure possible to enlightened medicine.

### SYMPTOMS OF CATARRH OF THE HEAD AND THROAT.

The head and throat become diseased from neglected colds causing Catarrh when the condition of the blood predisposes to this condition.

John Winner, 1118 Third Avenue City, cured of Catarrh of Head, Throat and Stomach.

"Is the voice husky?" "Do you spit up slime?" "Do you sneeze all night?" "Do you snore at night?" "Do you blow out snobs?" "Is the nose stopped up?" "Does your nose discharge?" "Does the nose bleed easily?" "Is this worse toward night?" "Does the nose itch and burn?" "Is there pain in front of head?" "Is there pain across the eyes?" "Is there itching in the throat?" "Is your sense of smell leaving?" "Do you hawk to clear the throat?" "Is the throat dry in the morning?" "Are you losing your sense of taste?" "Do you sleep with your mouth open?" "Does your nose stop up toward night?"

### SYMPTOMS OF CATARRH OF THE BRONCHIAL TUBES.

This condition often results from catarrh extending from the head and throat, and, if left unchecked, extends down the windpipe into the bronchial tubes, and in time attacks the lungs.

John B. McBurnth, 215 Pine Street, Jersey City, Cured of Catarrh of Bronchial Tubes and Stomach.

"Have you a cough?" "Are you losing weight?" "Do you cough at night?" "Have you a pain in side?" "Do you take cold easily?" "Is your appetite variable?" "Have you stitches in side?" "Do you cough when you get up?" "Do you cough on going to bed?" "Do you cough in the morning?" "Are you low-spirited at times?" "Do you spit up yellow matter?" "Do you cough short and hacking?" "Do you feel your lungs growing weaker?" "Have you a disgust for fatty foods?" "Is there a tickling behind the palate?" "Do you feel your throat raw?" "Is there a burning pain in the throat?" "Have you a pain behind the breastbone?" "Do you cough worse at night and morning?" "Have to sit up at night to get breath?"

### SYMPTOMS OF CATARRH OF THE STOMACH.

This condition may result from several causes, but the usual cause is "catarrh" of the mucous membrane of the throat and being swallowed.

Mrs. Luke Alexander, Portland, Conn.: "I was greatly benefited by Home Treatment. I do not need any more treatment for return of deafness. My hearing has come back and I can hear as well as ever, and my head and throat are thoroughly cured."

Charles F. Schaffer, Mystic, Conn.: "I want to tell the physicians and patients that every word that was spoken, I was hard of hearing for fourteen years. I haven't had a touch of catarrh for some time. The Copeland Physicians cured me of asthma and deafness by Home Treatment."

### THE GREAT SUCCESS OF HOME TREATMENT.

The system of treating patients who live at a distance has been so perfected that with the use of the Copeland symptom blank and patients' report sheets the percentage of cures by mail or home treatment is fully equal to the number of cures in the office. If you live away from the city write for Home Treatment.

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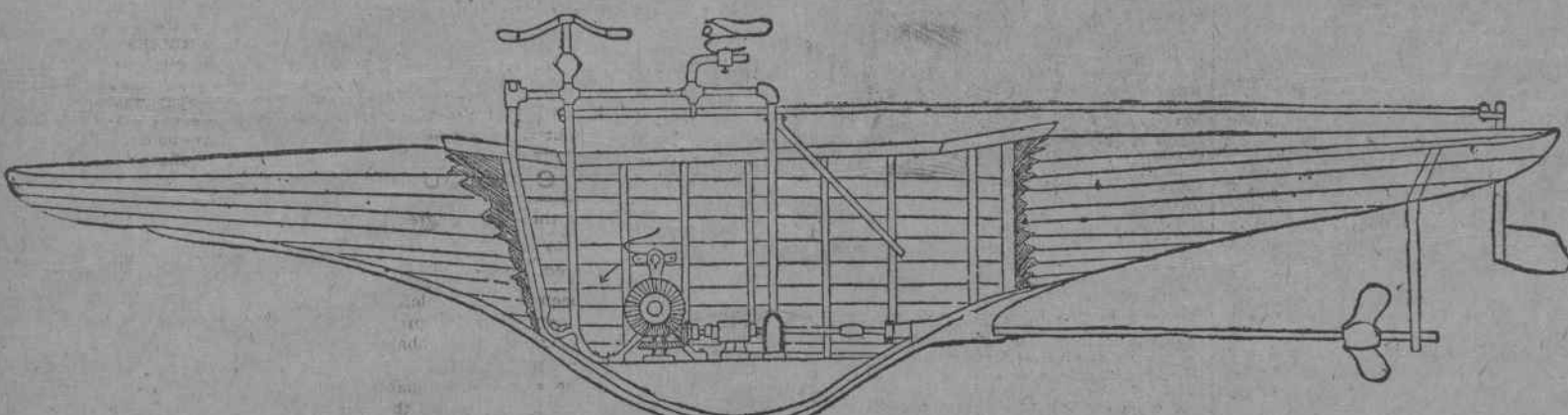
### DOCTOR COPELAND'S BOOK FREE TO ALL.

If you live out of the city write for Doctor Copeland's book containing a description by Doctor Copeland of "The Treatment That Cures, Doctor Copeland's Monograph on Deafness, Doctor Copeland's Monograph on Catarrh and Doctor Copeland's famous Symptom questions describing disease in its different forms. The book will be mailed to you FREE.

### CONSULTATION FREE.

The Copeland Medical Institute, OFFICES, 79 FIFTH AVENUE, Between 15th and 16th Streets, AND 315 MADISON AVENUE, Corner of 43rd Street, New York.

DOCTORS W. H. COPELAND, E. E. GARDNER, J. H. ST. JOHN, Office Hours—Day, 9 A. M. to 1 P. M.; 2 to 5 and 7 to 9 P. M. 39 So. 4th St., St. Louis.



THE BICYCLE BOAT ON WHICH THE RIDER MAKES 12 MILES AN HOUR.

which the cranks were attached directly to the driving wheel, the diameter of driving wheel which a rider could use was determined by the length of his leg.

"For this reason a 50 to 52 inch wheel was the common size, and a 60-inch wheel was an object of positive wonder on the road or on the track. This was the size ridden by Dr. Curtis (the Zimmerman of those days) when, in 1880-81, he astonished the world by riding twenty miles in one hour on the track. In those days it was largely the high velocity of the pedals that limited the speed, and every rider chose the largest wheel that he could comfortably bear, without impairing his effective work on the cranks.

"The introduction of the rear-driven safety bicycle, with its multiplying gear, has changed all that, and, as our illustration shows, the short rider can now bestride a bicycle the effective diameter of

whose driving wheel may be greater than that of our swiftest express locomotives. In passing it may be mentioned that if the rider of a 72-gear safety were seated upon an ordinary of equivalent diameter his eyes would look out upon the world from a point some nine feet above the ground, and riders of the 153-gear sextuplet would look down upon the earth from an elevation of fully sixteen feet.

"The distance travelled for one revolution of the cranks of the largest ordinary bicycle is 15 feet 8 inches; for the 92-gear racer it is 24 feet, and for the 153-gear sextuplet it is 40 feet, and such has been the improvement effected by the rigidity of the safety frame, the better position of the rider for his work, the excellence of the bearings, and, above all, by the recuperative action of the pneumatic tire, that the cranks of the 92-gear, modern, racing bicycle can be propelled with greater ease than those of the old 60-inch ordinary machine; as the respective speeds attained by two types would seem to prove. But while this is true on the race track, where the riders are men of muscle and endurance, on the country roads the advantages of excessively high gear are not so manifest.

"For although the rider of an 80-gear machine covers about a yard more ground than the rider of a 70-gear machine, at each revolution of his cranks he has to exert theoretically one-seventh more pressure upon the pedals, provided the other conditions, such as length of cranks and weight of rider and machine, be equal. Upon the level and on good roads this extra pressure is not depreciable, when once the machine is fairly under way; but upon a rough road, or in climbing a hill, or against the wind, the extra effort is very evident, and in the case of weak or tired riders, it is so.

speaks to the question of 'gear'

### BICYCLE BOAT AT SEA

A Queer California Water Cycle with Bevel Wheels in Place of Sprockets.

Captain Colin Thompson, a machinist of San Francisco, is constantly experimenting with cogs, pinions, shafts and "wheel things. He has built a water bicycle that comes nearer its shore prototype than any machine yet modelled.

It has a bona-fide bicycle frame, steering bars, pedals, seat and all complete in a boat. For the rear wheel of the land scorcher he has substituted a three-blade propeller, each blade being six and a half inches long.

1. LOWER GLUTEAN OR "SADDLE-GRIP" MUSCLES. 2. UPPER GLUTEAN OR "SADDLE-GRIP" MUSCLES. 3. EXTERNAL VASTUS. 4. DIGITAL EXTENSORS. 5. SUPINATOR LONGUS. 6. INTERNAL VASTUS. 7. GASTROCNEMIAL MUSCLES. 8. LUMBAR MUSCLES. 9. PECTORAL MUSCLES.

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take up the natural forward push of the propeller.

As the rider sits in the saddle he steers as he would aboard of his bike, the little 8-inch-square sheet-iron rudder leaving her to starboard and port with the greatest ease.

Captain R. B. Connell, of the California Swimming Club, recently manned the aqua-cycle—as the invention has been called—and speeded her away over the bay. There was a slight sea on, and the little craft under the flutter of its 38-inch pitch propeller danced over the waves like a duck.

He went ahead full speed, backed and swung around in a small circle. Notwithstanding that much of the rider's body is high above the rail, the machinery being below, the peculiar shape of the hull made the craft steady even in rough water.

mitting use of these sinews, and it is of the greatest importance that they should be strengthened and developed as much as possible.

A glance at the illustration shows how great a part they play in bicycling. It used to be said by the opponents of wheeling that its effect was to assimilate the human frame to that of the kangaroo, limbs and leave the trunk neglected. But, as the cut clearly shows, all the work done by the great from the centre and upper leg takes its origin from the muscles of poise in the lumbar muscles. Each time that the pressure upon the pedals is shifted from the right side to the left this important bunch of sinews in the back regulates the co-ordination of this shifted gravity with the balance of the upper body.



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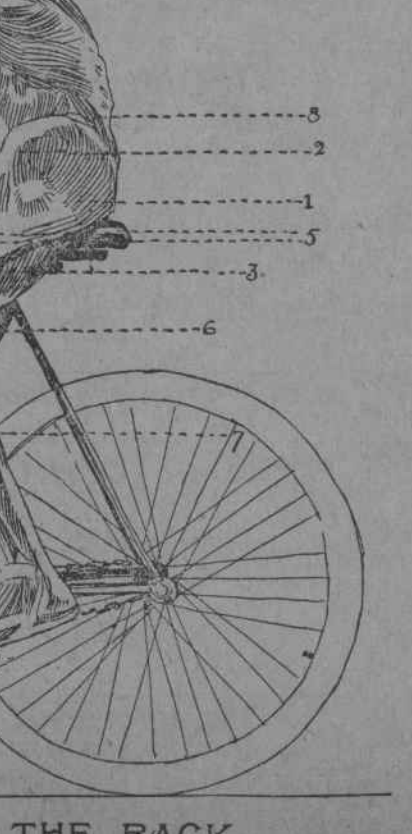
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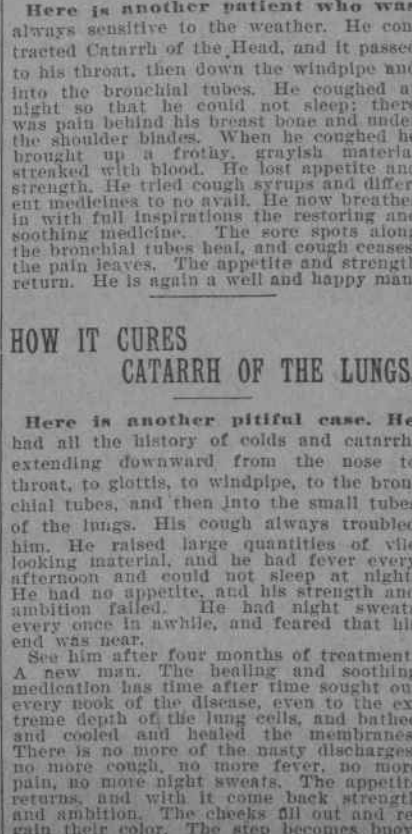
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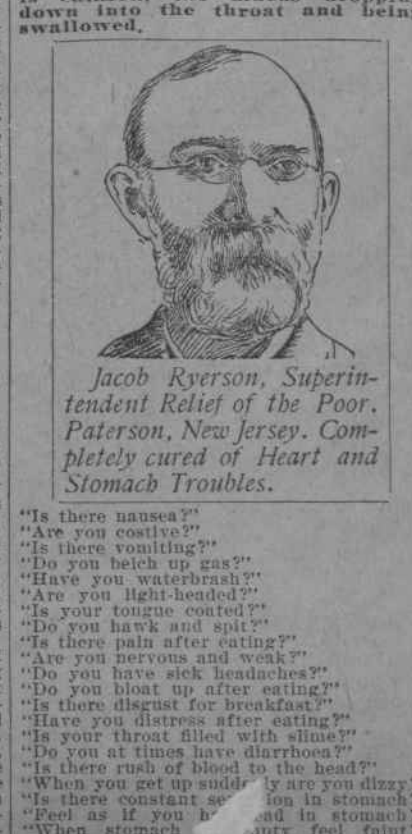
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